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Market Labor, Household Work and Schooling in South Africa: Modeling the Effects of Trade on Adults' and Children's Time Allocation

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Abstract:
This paper analyzes how economic policies can influence parents' decisions about their children's schooling, household work and leisure in South Africa. Using a dynamic computable general equilibrium model that integrates both market and non-market activities, distinguishing male and female workers on the one hand, and adult and child non-market work and leisure on the other, we find that, in the context of trade liberalization, gender inequality is likely to rise between adults and between boys and girls. Furthermore, the paper notes that the increase in adult male and female market labor supply is made possible through the substitution of children for parents in household work, although more so in some groups than others. These effects sustain in the long run.

Keywords: Household work, market work, child schooling, gender, time-use, trade, CGE model, South Africa

JEL Classification: C68, D13, F16, J13, J16, J22

Introduction

The pattern of children helping parents is common in most societies. In many parts of the developing world, children are required to perform certain chores as natural parts of their roles in the household, and this is seen as a means of socialization and part of the development of the child. These household work activities consist of managing the household, cooking, cleaning, washing the laundry, shopping, gathering fuel, wood and water and caring for other family members (younger siblings, the elderly and sick members). In developing countries, unpaid work also includes subsistence production such as production for home use of goods and services that can be marketable. The work undertaken by children may be essential, especially in rural areas and many informal urban settlements where there is lack of provisioning of adequate and affordable basic household infrastructure and services.

Looking at child labor issues with a gender approach uncovers distinct differences in the tasks performed and constraints faced by boys and girls. The role of girls in household production is similar to that of women. Women have primary responsibilities and do most of the work in the unpaid economy. In most developing countries, women are subject to "time poverty" as they have to combine their productive and reproductive roles. Almost everywhere in the developing world, women work longer hours than men, and girls work longer hours than boys. Furthermore, there is a high and disproportionate participation of girls in adult women's work, as opposed to boys' participation in men's work (ILO, 2004). This is explained by the fact that women's household work is easily substitutable with other females in the family, especially girls, , the clear gender division of labor, and the expectation that girls' future work will require the skills they are learning in helping with household chores and production (Kane 2004).

Although household work is usually considered benign by parents and society, it may be a strong deterrent to educational activities and the optimal development of a child. When children have to spend excessive periods of time on these chores, when they have to carry heavy loads over long distances or when they have to bear too much responsibility for their age, the household work they are doing becomes problematic. Furthermore, child work is detrimental to human capital accumulation. By not enrolling children in school, or by limiting the time that children who are enrolled have to do their homework and study, parents prevent their children from benefiting from higher earnings in the future. In poor households, this lack of schooling is likely to diminish chances of escaping poverty.

The relationship between child work and education is an important and complex issue. Parents' decisions regarding child work and schooling are influenced by perceptions of the costs and benefits of each option. The benefits from education are an important factor in parents' considerations. However, unlike the expected returns of education, work brings immediate benefits for the well-being of the family. This reality may undermine time devoted to education and even prevent parents from sending their children to school as education may have high opportunity costs for the family (i.e., loss of their domestic services and production). Parents' decisions could also be linked to their perception of the quality of the available education. Bad infrastructure, incompetent teachers or absenteeism are other factors that can play a role in parents' perception of educational outcomes. Parents' decisions between schooling and household work

are also highly dependent on living conditions, which affect the amount of work children will need to perform. For example, a child living in an area where water is available in the living compound will have more time for recreational or educational activities as his household work will not include fetching water, a highly time-consuming activity.

Findings suggest that during economic shocks, and particularly in poor households, family members' time may be one of the major resources available for adjustment. Indeed, policy reforms[1] can create a shift of costs from the market to the reproductive sector when the provisioning of marketable goods and services is met through increased unpaid labor (Elson 1995, 1999). This can contribute to the pressure to put all hands to work, including those of children, even at the expense of schooling. Children may be required to take on tasks of adults who have entered the labor market, or increased their hours worked in order to cope, for example, with falling wages. Children may also have to increase their household work to help produce goods and services that have become unavailable or unaffordable on the market (households may adjust to economic reforms by changing the composition of their consumption and by purchasing basic food items on the market and producing the rest at home).

Therefore, economic reforms not only affect and are affected by the division of labor within the household between men and women, but also between adults and children. Katz (1995) finds that the availability of older daughters to perform the domestic labor that is normally the responsibility of the female household head enables their mother to pursue remunerated labor activities in Guatemala. Hazarika and Sarangi (2005) find that children have to take up more domestic chores when adults increase their work in household enterprises following an improvement in access to microcredit in rural Malawi. Admassie (2003) finds that the immediate elimination of child labor in favor of schooling in Ethiopia is neither feasible nor desirable given the significant contribution of children's work to family labor and the household production system. Cockburn and Dostie (2007) find that demand for child labor within the household is determined by the household composition and assets, and that it plays a major role in children's time use.

Children are also income earners. Duryea and Arends-Kuenning (2003) find that children are more likely to leave school at times when they receive better pay in the urban child labor markets of Brazil. Duryea, Lam and Levison (2007) also show that loss of income due to unemployment of the male household head increases the probability of children entering the labor force and declining school performance. Kruger (2006) finds that child labor among boys increases during periods of temporary increase in local economic activity driven by positive coffee production shocks in Brazil. She also finds that parents from middle-income households tend to substitute their children's time from schooling into work activities. Shafiq (2007) shows that higher child wages (thus increased indirect costs of schooling) encourage households to combine schooling with child labor in rural Bangladesh. Amin, Quayes and Rives (2006) find that working inside or outside the household deters the continuous accumulation of education in Bangladesh and that working children have less schooling than non-working children. Edmonds (2005) finds that anticipated large cash transfers to the

[1] Structural Adjustment Programs launched in the 1980s, for example.

elderly in South Africa are associated with declines in children's time working of over an hour per day, as well as increases in their schooling. In line with the Baland and Robinson (2000) model, Edmonds (2005) shows that credit liquidity constraints play an important role in determining child time allocation. Heady (2003) finds that child labor has negative impacts on schooling not only in terms of quantity, but also in terms of quality. Learning achievement in reading and mathematics is substantially lower among wage-working children than among non-working children.

Clearly, child labor is harmful for education. However, child labor is often considered only in terms of labor for pay. Unpaid child work for family is commonly overlooked. Furthermore, gender differences are not taken enough into consideration. Our paper focuses on these dimensions. It illustrates how economic policies—trade liberalization in this case—can influence parents' decisions about their children's schooling, household work and leisure. The paper shows that expected returns on children's schooling play an important role, but that the need for the contribution of children in household production activities is a highly influential factor in parents' time allocation decisions. It illustrates how increased adult market labor supply can create a substitution of children for parents in household work. The paper thus analyzes the relationship between household economic shocks and the allocation of children's and adults' time.

A variety of tools, including econometric models and qualitative analysis, can be used to approach these dimensions. In this study, we use a computable general equilibrium (CGE) model.[ii] CGE models allow, within a comprehensive macroeconomic framework, the analysis of direct and indirect effects of macro-level shocks on production, on factor demand (labor, capital and land) and on income distribution. Furthermore, these models can distinguish between male and female labor. The non-market sphere, i.e. household production and leisure activities, can also be integrated. CGE modeling is thus an excellent tool for a gender-based approach to macroeconomic policy impact analysis as it can be made to reflect changes in labor market participation, the degree of inequality in income distribution, and the division of household chores, with each element distinguished by gender.

This paper is organized as follows. The following sections outline our general approach and explain how the data are organized in the case of South Africa. Next, we provide a description of our CGE model and report the results of the experiments. The final section concludes and outlines further work plans.

Our Approach to CGE Modeling

CGE modeling is widely used to evaluate the impact of trade policies. However, as noted, few studies adopt a gender-aware approach to such policies and incorporate home-produced goods to analyze labor supply decisions. Fontana and Wood (2000) built a CGE model that treats men and women as separate factors of production in the market sphere, as well as in the spheres of household production and leisure activities. Their model is applied to Bangladesh. Fontana (2004) develops this approach from a comparative perspective between Bangladesh and Zambia, finding that the full elimination of import tariffs results in an increase in female wages and labor force participation. In both countries, higher female market employment results in a decrease in women's household work and leisure activities. In Bangladesh, given the increase in the opportunity

cost of female workers' time relative to male workers, this encourages some substitution of male for female labor in household work.

Fofana, Cockburn and Decaluwé (2005) build a CGE model that also integrates both market and non-market activities distinguished by gender for the South African economy. Import tariff elimination reveals a strong gender bias against women, with a decrease in their labor market participation, while men participate more in the market economy. They find that women continue to suffer from heavy time burdens within the household, with an increase in their domestic work. In contrast, men perform less domestic work, and contribute more to household income.

Despite the innovative features in these models, a few improvements can be brought to them. Even if the increase in female market labor supply—in the Fontana and Wood (2000) model—is positive in terms of women's income contribution and bargaining power within the household, it may adversely affect other household members, especially when the production of home goods and services is maintained through an increase in tasks performed by other members, particularly children. The observed increase in market employment may not be met through the reduction of leisure time, particularly when time-saving goods and services are unaffordable or unavailable. Hence, economic incentives in terms of increased wages and labor demand may be met through the substitution of children for parents in home production activities. Furthermore, these earlier CGE models fail to account for long-term impacts.

No CGE model, to our knowledge, has considered evaluating trade policy impacts on children's household work, education and leisure within the household context. Most research considers children's labor for pay and overlooks their unpaid labor for the family. Our paper seeks to fill this gap and brings new insights on this issue. The integration of children's unpaid household work allows us to monitor whether girls and boys are likely to be deprived of school in order to perform household tasks that their employed parents no longer have time to do. Our research is further set apart in its long-term approach, which allows us to identify whether gains or losses in terms of education as a result of greater trade openness would be sustained over time.

Data

Our CGE model uses the South African social accounting matrix (SAM) [iii] for the year 2000 built by Fofana, Cockburn and Decaluwé (2005). A SAM is designed to characterize and understand the structure of an economy. It summarizes the transactions among economic agents and sectors in an economic system within an accounting period of generally one year. Our SAM has 27 market production sectors producing 27 categories of goods and services, using two factors of production—capital and labor, with labor disaggregated by gender and by skill level. It has four household categories distinguished by race, reflecting the historical divide inherited from the apartheid regime until 1994. This disaggregation by population group is important as it reflects variations in skill level, sectoral employment, wages, income composition and consumption patterns. These factors are influential for our simulation results as the initial shares play a key role. For instance, labor income represents 73.2 percent of "African" households' total income, while it reaches 87.1 percent for "Colored" households, and 85.5 percent and 84.7 percent for "Indian" and "White"

households respectively. This implies, in relative terms, that a decrease in labor income will affect Colored households significantly more than the others. Similarly, around 25 percent of Colored households' labor income comes from unskilled male labor remunerations, while the shares for the three other household racial categories are slightly less. We can therefore expect that a decrease in unskilled male labor demand and wages will have a greater impact on Colored households. Also, the four household categories differ in their sectoral employment. African households are relatively more employed in the agricultural and mining sectors. An expansion in the mining sector will therefore benefit them relatively more.

Unlike many SAMs, ours integrates household production activities recognized as "non-economic but productive" activities by the standard international system of national accounts (SNA) classification of 1993 . These activities, also called reproductive work, are distinguished by gender and age for each household category and include rearing and caring for children, caring for other household members, cooking, cleaning, fetching water and fuel, etc.

The SNA is a multi-purpose system designed for economic analysis, decision-making and policy-making. National production is a key concept because the "production boundary" (or the way that production is defined) determines what is or is not to be included as production. Generally, women's concerns, priorities, and contributions to economic production are excluded from the data that provide the basis for preparation of national accounts. The extended production boundary of the 1993 revision of the SNA partly addresses gender issues, although the revision largely covers only the monetized market economy. Women and men tend to undertake different roles in the economy and in society. Men tend to engage in remunerated market activities whereas women engage in low-paid activities and play a dominant role in the non-market economy. Women's and girls' work and contribution to both the market and household tends to be invisible and therefore unmeasured. Differences in the roles of men and women (and boys and girls) may lead to unintentional gender bias in policies and programs.

Allowing a better and more complete understanding of women's contribution to national production requires taking into consideration market and non-market activities. Making women's "invisible" unpaid work "visible" requires consideration of time spent on non-market activities. Time use surveys can make visible the role of women as active contributors to both economic and domestic activities. Time use surveys also serve to demonstrate the disparities that exist between men and women in terms of hours spent on various types of tasks, including economic, educational and leisure activities. This is done through the construction of "satellite accounts," which measure the value of domestic labor and leisure. These are additional accounts linked to the National Account, which increase the analytical capacity of the system without overburdening or disrupting it. Their main purpose in this case is to obtain separate estimates of gross household production, thus extending the production boundary. These estimates can then be used to trace the joint evolution and interaction between the two economies: the monetary market economy as reflected in the SNA and the non-monetary household economy in the satellite accounts. Household and personal activities can then be incorporated in a SAM.

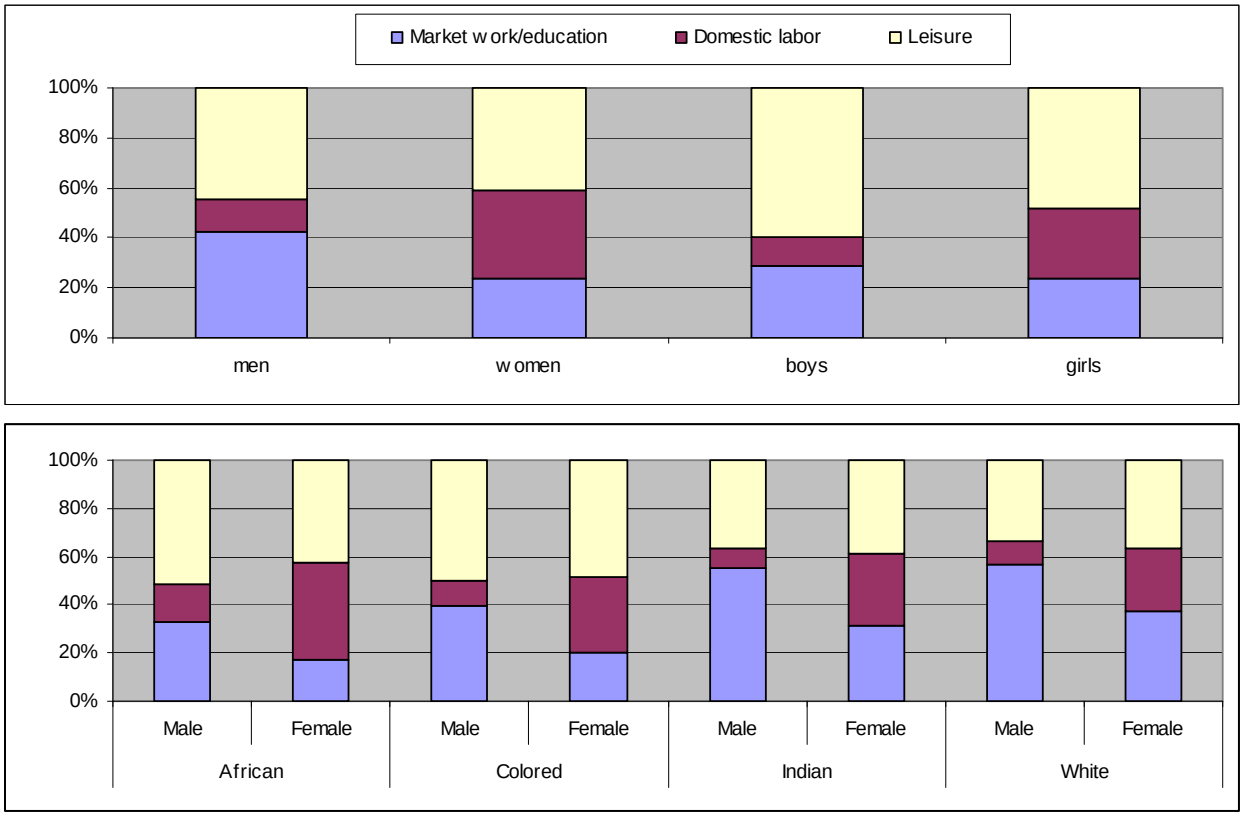
The SAM is built following this classification based on data from the 2000 South African Time-Use Survey. Information on children's work (under the age of 19) is provided by this survey and by the Survey of Activities of Young People in South Africa (Statistics South Africa 1999). The SAM provides information on labor in terms of hours, since all household members are engaged in at least two types of activities. As mentioned above, it uses satellite accounts for non-market activities (leisure, household production and education).

	Share in time use (%)				
	African	**Colored**	**Indian**	**White**	**Total**
Men					
Market work	32.9	39.5	55.2	56.6	42.7
Domestic labor	15.5	10.8	7.9	9.5	12.6
Leisure	51.6	49.7	36.9	33.9	44.6
Total	100.0	100.0	100.0	100.0	100.0
Women					
Market work	17.4	20.0	31.5	37.0	23.9
Domestic labor	40.4	31.7	29.5	26.5	34.9
Leisure	42.3	48.3	38.9	36.5	41.2
Total	100.0	100.0	100.0	100.0	100.0
Boys					
Education	32.4	22.3	32.2	21.2	28.7
Domestic labor	11.4	10.0	8.6	12.6	11.5
Leisure	56.2	67.8	59.2	66.2	59.9
Total	100.0	100.0	100.0	100.0	100.0
Girls					
Education	26.9	20.5	27.0	17.9	24.1
Domestic labor	28.7	24.5	24.8	27.1	27.7
Leisure	44.4	55.0	48.2	55.1	48.2
Total	100.0	100.0	100.0	100.0	100.0
Household Work					
Men	27.4	24.4	24.3	31.2	27.9
Women	53.4	56.4	56.5	49.5	52.8
Boys	6.5	5.8	5.8	7.4	6.6
Girls	12.7	13.4	13.4	11.8	12.5
Total	100.0	100.0	100.0	100.0	100.0

The allocation of time in South African households between market work, household work and leisure for adult men and women, and between schooling, household tasks and leisure for girls and boys is outlined in Table 1. Women spend significantly more time in home production activities while men are more engaged in market production activities (Figure 1). Adult women provide half of the labor time needed to produce home goods and services while adult men contribute up to 27 percent.

Table 1. Time allocation in South African households, SAM 2000

Figure 1. Gender time allocation by population group (SAM 2000)



This gender division of labor is also reflected between girls and boys, as girls provide twice the household labor that boys supply. Girls also have relatively less time for schooling and school-related activities and leisure given their higher household work load (Figure 1). Overall, females (adults and girls) provide over 65 percent of the household labor. Their time allocation is therefore more constrained than that of men and boys. Males (adults and boys) benefit from higher leisure time while women and girls have a higher work load.

Table 2 shows that children aged from ten to 19 years spend more than one hour per day on domestic tasks, excluding care activities. Children spend relatively less time on household chores than adults. The South African Time-Use Survey also shows that women spend at least twice the time of men in these tasks. Inequality in the gender division of labor is also reflected within the under-19 age group. Girls spend over two hours per day on fetching water and fuel while boys spend only 68 minutes on these tasks. Furthermore, women and girls are more likely than men and boys to bear responsibility for collecting water, particularly in ex-homeland areas. When considering child care activities, the survey shows that women with children living with them spend an average of 87 minutes a day on child care, compared to an average of seven minutes for men in this position.

Table 2. Mean minutes per day spent on domestic work—including fetching water and fuel, but excluding care—by gender and age

Age	Male	Female
10 to 19	68	131
20 to 39	87	224
40 to 59	81	232
60 plus	91	187

Source: Statistics South Africa 2001

Information on children's work-related activities is provided by the Survey of Activities of Young People in South Africa (SAYP) (Statistics South Africa 1999). This survey illustrates how work fits into the daily lives of children aged from five to 17. The survey confirms that children's level of involvement in household work depends on their physical environments.

Activities such as fetching water and collecting wood for domestic use are related to children's living conditions and are the most common activities in which South African children participate. During the survey period, only 37 percent of homes in which children aged 5-17 years lived were using electricity for cooking. Fetching water and gathering wood are characterized as highly time-consuming activities and often recognized as detrimental to children's development (SAYP, Statistics South Africa 1999).

Location also plays an important role in the work undertaken by children. Children living in deep rural areas with no access to services, mainly former homelands, are more likely to be engaged in household chores such as collecting water and wood than those living in commercial farming areas, or informal or formal urban areas. Indeed, about 51 percent of children lived in households without tap water in the dwelling or on site. Only 16 percent of children living in rural areas, mainly in the former homelands, had a tap inside the dwelling or on the site where they lived during the survey period. This proportion increased to 42 percent for children living in urban informal settlements and to 53 percent for children living in commercial farming areas. But 94 percent of children living in formal urban areas had a tap inside the dwelling or on the site where they lived.

Considering all household work activities in terms of racial category, African children were found to be most engaged, followed by Colored, Indian and White children. Nearly one-third of African children were engaged in fetching wood and/or water, versus a very small percentage of children in other racial categories. The SAYP revealed that seven out of ten African children engaged in work activities mainly on school days, one in 25 of them during school hours. Only one-quarter of them did these activities mainly over weekends and during holidays. The survey also showed a substantially higher number of girls involved in these activities than boys across all household categories.

The survey results show that children's economic and non-economic activities did not keep them out of school. The problem for children is apparently not that

work prevents them from attending school; rather, their work activity results in a lack of time to do homework, catch up with lessons, and study, as well as time for recreational activities. Only 6 percent of boys and 1 percent of girls who engaged in economic activities (including fetching water and wood) said that the work they were doing actually kept them out of school, but work still affected their progress through school. Among children aged 13 years, 40 percent of those who did not work had completed primary school, compared to only 17 percent of those who were engaged in work. This difference decreases as age increases. For example, among 16-year-olds, 85 percent of those who did not work had completed primary school, versus 76 percent of those who worked. Nevertheless, this shows that children engaged in work activities are likely to progress through school more slowly than their non-working peers.

The Model

This study uses an adapted version of the standard computable general equilibrium model presented in Decaluwé, Martens and Savard (2001). The standard model structure and macroeconomic closures, as well as some technical aspects, are provided in the Appendix. The principles underlying the gendered aspects are available in Fofana, Cockburn and Decaluwé (2005) and Mitik (2007). This section outlines the structure and main hypothesis of the model.[2]

The treatment of trade in the model is standard. We assume that the relationship between the rest of the world and the domestic economy is determined by an imperfect substitution[i] between imported and domestically produced goods and services on the consumption side (the Armington hypothesis). Local producers divide their output between local and export markets; the shares vary with the ratio of domestic to export prices. Thus, allocation between domestic and foreign markets for demand and supply respond to relative prices of foreign goods defined by international import and export prices, relative to the price of home goods and the local tax levels. Our model is run on a dynamic basis enabling the evaluation of long-term impacts. We use a sequential dynamic model, that is to say a multiple steps model, to evaluate long-term impacts.[3] The model works in such a way that in each step or period, the stock of capital is accumulated and investment by sectors of destination is defined following the specification of Bourguignon et al. (1989).

Gender Specifications and Household Production Activities

Our CGE model, unlike the Decaluwé, Martens and Savard (2001) models, is based on a gender sensitive approach on the market sphere. The labor market is segmented into male labor and female labor treated as separate factors of production. This is intended to reflect gender bias in terms of wages and employment opportunities in the South African labor market as well as occupational differences. Some sectors are male intensive (e.g., the mining sector) and others female intensive (e.g., garments and textiles).

Another distinctive feature of our model is the integration of household production and leisure activities distinguished by gender and between adults and

[2] Model equations and optimization processes can be provided from the authors upon request.

3 Standard dynamic model specifications are based on the approach by Annabi, Cockburn and Decaluwé (2004).

children. The household production structure is based on the Fofana, Cockburn and Decaluwé approach (2005); labor supply is endogenously determined within households, as women and men allocate their time between market labor, household work and leisure. We extend their approach by distinguishing between adult and child household work. Furthermore, we introduce parents' decisions on child time allocation between education, household work and leisure time. Non-market activities are introduced into the model with the recognition that women and girls are more likely to perform household chores while men are more active in the labor market.

Modeling market activities alongside non-market ones shows the importance of home production of goods and services as they are intensive in female labor. This reveals the constraints faced by women in terms of their ability to increase their labor market participation, and the constraints girls face in terms of time available to devote to school-related and recreational activities. Furthermore, these home-produced goods and services are not sold in the market and they compete with their market substitutes. They thus play an important role in households' consumption choices. "Household utility" is based on the consumption of home-produced goods, marketed goods, and leisure time, each considered as imperfect substitutes.[4]

Children's Time Allocation

We assume a perfect substitutability between adult and child household labor. This is likely to result in an increase in girls' and boys' household work in situations where women and men need to increase their labor market participation. Girls replace their mothers for some household chores while boys take on tasks mostly performed by their fathers. Nevertheless, parents cannot increase children's household work as much as they want because girls' and boys' disposable time is constrained by an imperfect substitution between household work and schooling. Their time allocation function is a constant elasticity of transformation (CET) function with a substitution elasticity of 2. This coefficient shows how strong the trend is to substitute time in school with time at household work. Given that the value is positive and more than 1, 2 in this case, the chances of substitution are high. This implies that parents' decision to allocate their children's time between schooling and household work will vary significantly with relative gains. This functional form is interesting because it avoids situations where children are taken out of school to perform household work when relative gains of education decrease (which would represent a perfect substitution case) in accordance with the observed situation in South Africa. Time allocated to education and household chores is determined in such a way that it maximizes girls' and boys' hypothetical future income. Leisure time is determined once children's time has been allocated to education and household work.

Households' decision to allocate time for children's education is modeled in a relatively simple manner: it depends on changes in "skill premium"[5] distinguished by gender. Children's household work is valued by unskilled market

[4] The household utility function is an extended linear expenditure system from which are derived household demand functions subject to a full income constraint.

[5] Skill premium represents the rate of return of skilled labor relative to the rate of return of unskilled labor. It is the average female and/or male wage ratio between skilled and unskilled labor.

wage rates, as we assume that time not devoted to schooling is unlikely to produce skilled labor. Education is, however, expected to produce skilled laborers and is thus valued by skilled wage rates.

Children's household work level is affected by the need for their contribution to help and/or replace parents, providing direct utility to the household because their work allows for higher consumption of home-produced goods. However, allocation of time is mainly determined by future prospects in terms of higher income, though schooling does not provide any utility to the household in our model (see Figure 2).

Men and women allocate their time between market and non-market activities according to home goods production requirements, the degree of substitutability between men and women in the market and non-market spheres, market wage rates (and opportunity costs), and the labor demand in different sectors. Children's contribution in terms of household production also plays an important role because boys and girls can be substitutes for adults in home production activities. This has a double advantage for the household. First, it frees time for adults to work in the market sphere and thus increases the consumption of market goods and services by household members. Second, it helps maintain the level of production and consumption of home-produced goods for the household. As education does not bring immediate well-being to the family, less schooling does not directly affect the household; only the child will be affected in the long term.

Model Advantages and Limitations

Before outlining the major results of the policy simulation, it is important to point out the advantages and the limitations of our approach. Of course, it should be kept in mind that results are to be interpreted within the model structure and assumptions.

The principal advantage of analyzing a policy question in a CGE context is that this approach can take into account interactions throughout the economy. In addition to a well-defined theoretical structure, the CGE approach has a detailed accounting framework to take into consideration the structure of any economy. However, results of these models are sometime criticized on the grounds of the unrealistic nature of their underlying assumptions, i.e., optimizing behavior, competitive markets, relative price, flexibility, etc. We believe, however, that the strength of this type of model is its consistency with generally accepted microeconomic theory and with the nature of an interdependent economic system, where a change in one area of economic activity may have a non-trivial impact in another area. The lack of econometric estimation is also sometimes presented as a weakness of CGE models, but undertaking significant sensitivity analyses, that is to say, analyzing the impact of changes in the parameters, will permit us to see which parameters are key components in altering the results in terms of magnitude and eventually in sign.

Another characteristic of our approach is the fact that education is valued by actual skilled wages. An alternative method to value education is to use expected wages of skilled workers depending on the estimated number of schooling years necessary to become a skilled worker and the interest rate. A comparison between lifetime income with more education and lifetime income with less

education can be introduced to explain parents' school/labor decisions. A variety of other sophistications of our approach are also possible; for example integrating market work for children, taking into account the age of children in order to capture a possible substitution between older and younger children's participation in household work, or taking into account the level of parental education. For the moment we have limited ourselves to the major characteristics, but it is clear that future work and extensions could eventually enrich the approach and influence the results.

Simulation Results

We used our CGE model to analyze the effects of trade liberalization, simulated in this case as the abolition of all import tariffs. South Africa has a moderate level of protection, partly as a result of liberalization programs implemented since 1994 by the Growth, Employment and Redistribution (GEAR) policy. The average tariff or import tax rate is 3.36 percent. The dispersion of the tariffs around the average is high. Tariffs range from zero in all services sectors to 26 percent in the footwear manufacturing sector. In the agriculture and mining sectors, import taxes are less than 1 percent. The manufacturing sectors are highly protected (9.01 percent). Tariffs constitute approximately 3.36 percent of total government revenue, while direct taxes contribute up to 29.56 percent and other indirect taxes represent 53.30 percent of total government revenue.

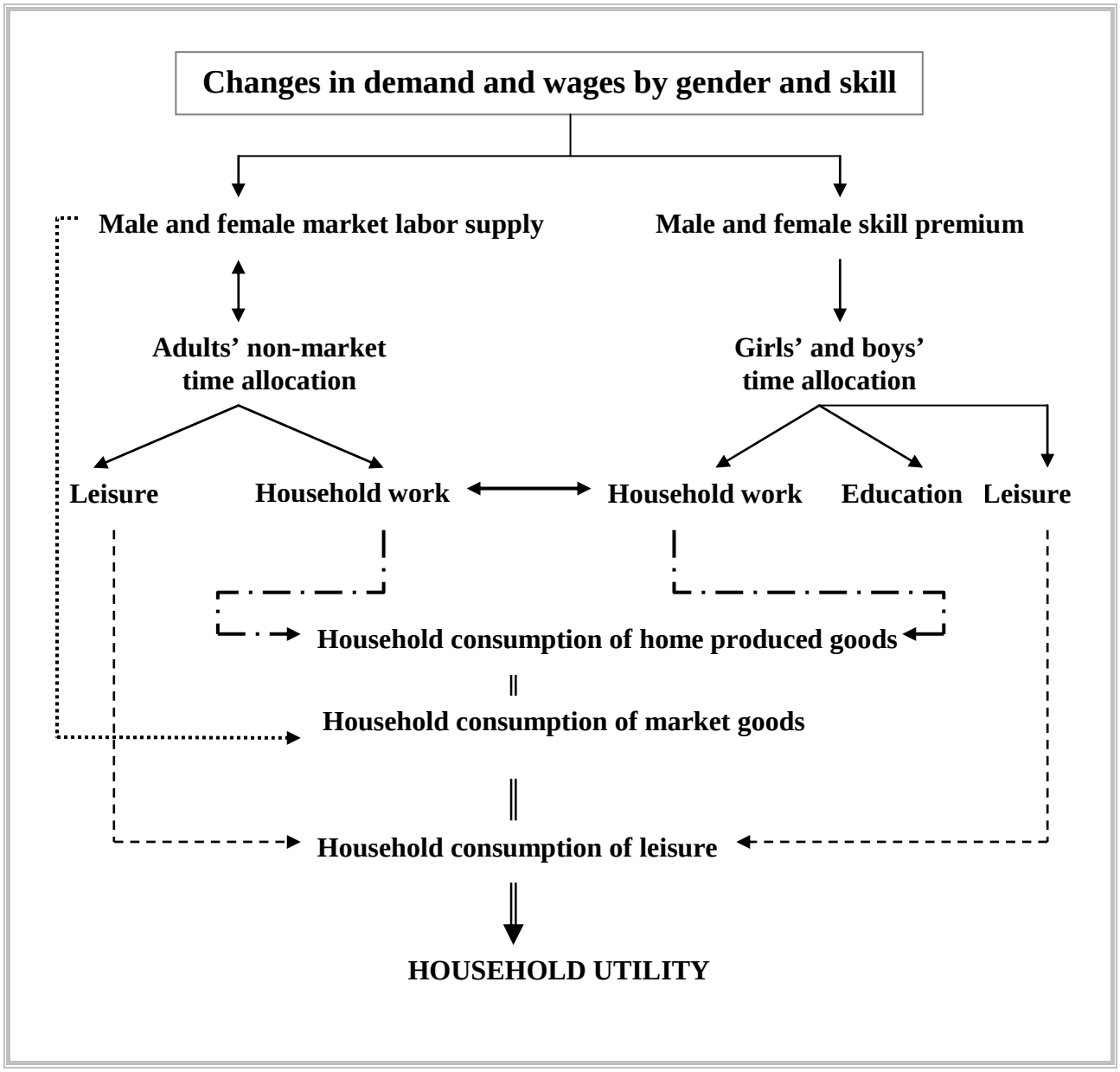
We first present the short-term impacts of abolishing tariffs before outlining the long-term trend. According to our model, the removal of tariffs in South Africa modifies the relative prices of all goods and services, resulting in a decrease in aggregate output and GDP but an increase in imports and exports. When all tariffs are removed, the total volume of imports increases. Imports increase the most in manufacturing and in previously highly protected sectors. Resulting from the real exchange rate depreciation, exports rise mainly in male-intensive mining sectors. Variations in exports and domestic sales determine the changes in output. Domestic demand is only marginally offset by increases in exports. Greater exposure to international competition causes domestic market output and prices to fall. The sectors with the most substantial reduction in local sales are initially highly protected sectors. The sectors which expand the most are export-intensive sectors like mining and basic iron and steel manufacturing, followed by some services sectors. These sectors benefit from their strong positive export response, the large initial export shares and the large input cost reduction.

Trade liberalization affects women and men differently, and this depends on which sectors expand or contract. We have already pointed out that men are more active in the labor market than women, whereas women are more involved in domestic work across all population groups (Figure 1). Also, men and women tend to be employed in different sectors. Most sectors are male-intensive with the exception of textiles, garments and some service sectors such as trade, health and social work. Our model indicates that trade liberalization in South Africa seems to increase gender bias. We observe a slight reduction in aggregate female labor market participation while aggregate male labor market participation increases. It also appears to generate a greater real wage reduction for women than for their male counterparts. Our results thus indicate that gender inequality in the labor market is likely to increase with trade liberalization. This is due to the fact that female workers are more concentrated in textiles and certain

service sectors where value added price and production fall, resulting in a decrease in female labor demand. Given that male workers are highly concentrated in export-intensive sectors—e.g., all mining and iron sectors—that benefit relatively more from a fall in input prices, male labor demand increases.

When disaggregating by gender and skill, we find that changes in wages and labor market participation have two transmission patterns, one affecting adults' time allocation, and one affecting children's time allocation. Figure 2 illustrates the time allocation process, as explained below.

Figure 2. Structure of time allocation decisions



Impacts of Trade Liberalization on Adult Time Allocation

The four racial categories of households respond differently to changes in real wage rates for female and male workers by adjusting the time they spend in market labor, home labor and leisure time depending on their labor endowments

by skill and gender, their capital endowments and their employment sector. Labor market participation decision is a mix of labor and non-labor income effects which differ for the four household categories (Figure 1). Decisions about whether or not to become employed depend on a number of factors, concerning both the labor market and the situation within the household (e.g., who else is employed, other sources of income, and the activities within the household that contribute to survival). These factors vary for the different household groups in question. Higher wage rates in the market do not necessarily mean more people becoming employed.

Gender bias, measured in terms of labor market participation, is believed to increase in African, Indian and White households while it decreases in Colored households.[6] Moreover, given the greater reduction in female wages, gender bias is likely to diminish women's contribution to the household income, thus reducing their bargaining power within the household.[7] Colored households have a different behavior in this regard than the three other household categories (Table 1). This is mainly explained by differences in initial endowments. Colored households are less endowed with skilled male workers who win from the elimination of tariffs. They are also relatively more endowed with unskilled male and skilled female workers who encounter the highest losses in terms of labor income. Also, Colored households' income is more dependent on labor income relative to the other household categories. The overall decrease in labor income will affect them more, and require a substantial increase in market labor supply to maintain a certain level of consumption of market goods and services, which in turn affects their well-being. Finally, female market labor supply increases more than that of male market labor in Colored households. This is explained by the fact that women in Colored households benefit from the reduction in female labor supply from African and White households while total female labor demand in the economy diminishes very slightly.

Table 3. Time allocation effects (%)

	Girls' Home labor	Girls' Educa-tion	Women's Domestic Labor Supply	Women's Market Labor	Skilled Female Labor	Unskilled Female Labor	Aggregate Female Domestic Labor
African	0.05	-0.65	0.27	-1.50	-1.53	-1.46	0.20
Colored	2.49	1.77	-2.10	7.36	7.34	7.41	-1.22
Indian	0.42	-0.28	-0.15	0.14	0.12	0.18	-0.05
White	0.09	-0.61	0.16	-0.40	-0.42	-0.35	0.15
	Boys' Home Labor	**Boys' Educa-tion**	**Men's Domestic Labor Supply**	**Men's Market Labor**	**Skilled Male Labor**	**Unskilled Male Labor**	**Aggregate Male Domestic Labor**
African	-1.26	0.38	0.47	-0.38	-0.32	-0.49	0.17
Colored	3.10	4.81	-2.37	3.17	3.23	3.06	-1.29
Indian	-0.67	0.98	-0.04	0.24	0.29	0.13	-0.13

[6] Gendered impacts of trade liberalization as it channels through the overall economy following changes in import prices is addressed only briefly here, as the focus of the paper is on children's time allocation. These results can be made available upon request.
[7] This is not, however, modeled in this paper.

White	-0.95	0.70	0.25	0.03	0.08	-0.09	0.03

Changes in market labor supply come through an adjustment of household work and leisure time. Men primarily adjust their time by reducing their leisure and then their household work. In contrast, women adjust their time through changes in domestic work and then by adjusting their leisure time, except in Colored households. In consequence, trade liberalization seems to reduce gender bias towards women in terms of gender division of domestic work within the household except for the Colored group. We note that women are able to maintain their leisure time due to the increase in girls' household work. We also observe a clear substitution of children for parents in Colored households. Indeed, the higher labor market participation of adults tends to significantly increase girls' and boys' home labor.

Impacts on Children's Time Allocation

Following the greater decline in female skill premium, parents tend to reduce girls' education time and increase their household work in African, Indian and White households (Table 3). Conversely, given the increase in male skill premium, parents increase boys' education time while reducing their household work load. Gender bias in terms of education time is therefore likely to rise between children in these three population groups. In contrast, gender inequalities between children are less likely to increase in Colored households. Unlike girls in the three other household categories, girls in Colored households benefit from an increase in education even if their education time increases less than that of boys. This is related to the form of the time constraint function (or the set of limitations imposed by external conditions).[iv] However, domestic work for both girls and boys increases significantly, resulting in a reduction in leisure time. On the one hand, given that adults' market labor increases considerably in Colored households, they adjust their non-market time through a reduction in their own leisure and then in their domestic work. On the other hand, they also substitute children for parents in household production activities in order to preserve a certain level of welfare for the family (through the consumption of home produced goods and services).

We clearly observe a substitution effect of children for parents in Colored households. Given the significant increase in adult male and female market labor supply, some of the household production activity is maintained through the increase in girls' and boys' home labor. Even if changes in male and female skill premiums vary in the same proportions for all household categories, parents' school/home labor decisions are different in Colored households.[8] Girls' home labor increases significantly more in Colored households than in the three others. Boys' home labor also increases in Colored households, but diminishes in African, Indian and White households following changes in relative gains from education and home labor. Nonetheless, this direct substitution effect does not negatively affect children's education in Colored households. Instead, parents tend to adjust children's time through a reduction in pure leisure time.[9]

[8] This is explained by the initial difference in factor endowments between the four household categories and their consumption and spending patterns.

[9] This is related to the functional form of the time constraint function where the child's hypothetical income is maximized in such a way that household utility is maximized.

A certain substitution effect also takes place in African, Indian and White households. However, it is important to note that this effect is mainly related to changes in male and female skill premium. Indeed, the increase in girls' home labor frees some time for adult women in African, Indian and White households. In contrast, the reduction in boys' home labor explains why men are forced to adjust their non-market time through a greater reduction in their pure leisure time.

Seemingly, the substitution of children for parents is a result of changes in relative gains from education and home labor. However, when adults' labor market participation is high, as in the case of Colored households, there is a pure substitution effect of children for parents in home production activities.[v]

At the household level, we note that trade liberalization results in a reduction in real income and consumption of marketed goods and services in all households,[10] though more for Colored households, followed by Indians, Whites and finally African households. Consumption in home-produced goods and services increases, however, for African and White households.[11] In Colored households, even if parents reduce their home production less and increase girls' and boys' domestic work significantly, this is not sufficient to maintain their initial level of non-market goods consumption. In Indian households, the increase in girls' domestic work is not high enough to compensate for the loss of domestic work of adults and boys.

Overall, we note that the trade liberalization shock results in a reallocation of all household members' time, illustrating that changes at the market level are likely to affect the household economy. Intra-household gender inequalities seem to rise not only between adults but also between children. Boys benefit from an increase in education time while parents substitute more of girls' education time for home labor. As male labor market participation increases, men continue to perform relatively less domestic work and contribute more to household income. This is likely to reduce women's bargaining power in the household. Females are still affected by heavy time burdens given that when adult women do not increase their home labor, the gap is filled through an increase in girls' participation in home production activities. The biggest winners in terms of increased labor market participation are men in Colored, Indian and White households and women in Colored and Indian households. However, they only represent a minority given that "Africans" represent over 80 percent of the South African population. In consequence, inter-household (inter-racial) inequalities are likely to rise.

Trade liberalization resulted in a decrease in domestic and import prices, but an average decrease of market prices does not mean an increase in households' real income (or purchasing power). Instead, trade liberalization constrains households to reduce their consumption of market goods and services. The decrease in consumption is higher in Colored households, followed by Indian, White and African. Consumption of home-produced goods also declines for Colored and

[10] This is partly related to the introduction of compensatory indirect tax which results in a slight increase in prices.
[11] This is also due to the increase in girls' home labor following the fall in returns to their schooling.

Indian households while it increases for African and White households. Tariff reduction thus translates into an improvement in welfare for African households, while it results in a welfare loss for the three other household groups, especially Colored.

Long-Term Impacts of Trade Liberalization

Over a period of 20 years, the negative impacts of trade liberalization on the overall economy seem to diminish. Market demand for female labor increases slightly, and aggregate male labor demand increases relatively more than in the short term. Households' real income and consumption decrease more in the long term.

Time allocation for adults follows the same trend as in the short term (Table 6). Overall, gender disparities are believed to narrow within Colored households in the long term given that female labor supply increases more than male labor. In contrast, gender disparities are likely to widen in the other three household categories as market labor supply decreases more for women relative to men in the long run.

Table 4. Long-term impacts on adult time allocation (changes in percentage from base year scenario)

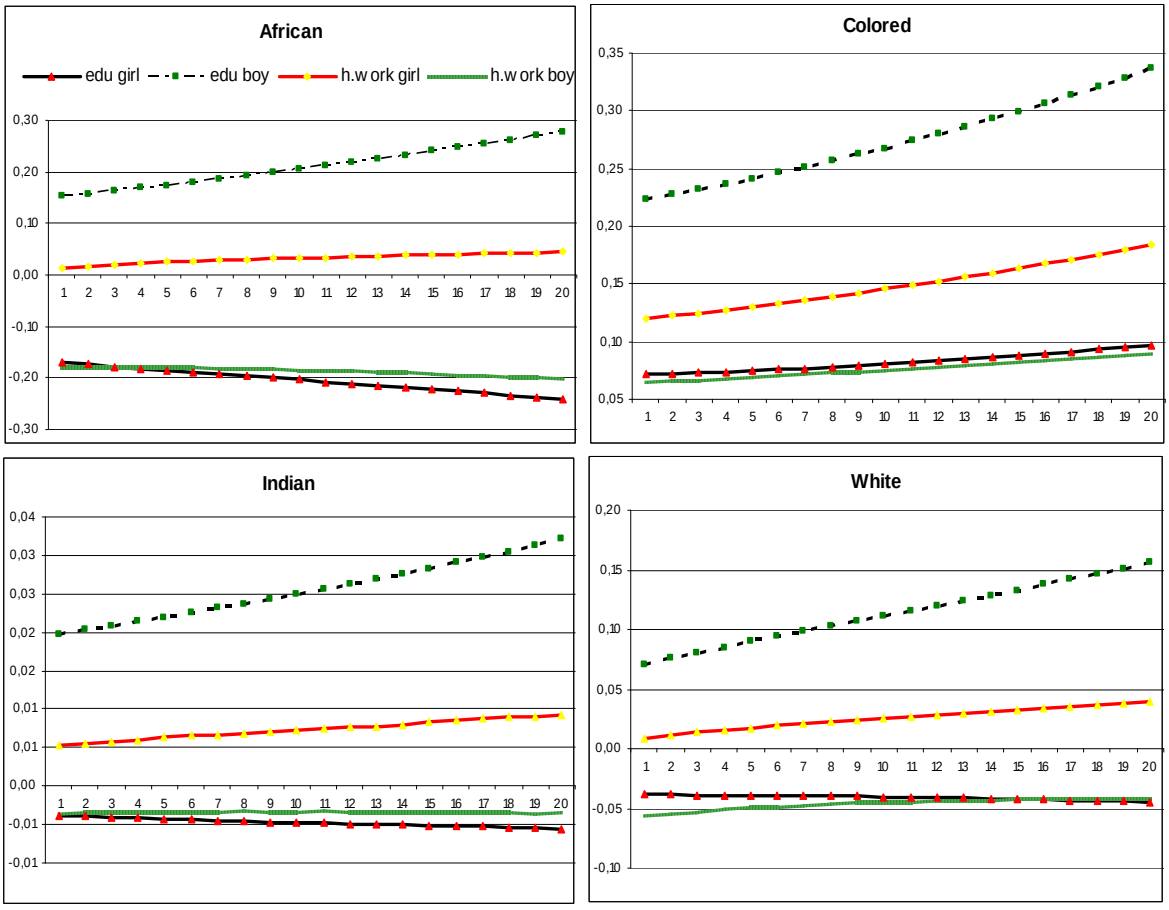
	Period 1	Period 5	Period 10	Period 15	Period 20
Female market labor supply					
African	-1.50	-1.44	-1.40	-1.38	-1.39
Colored	7.36	6.89	6.42	6.05	5.74
Indian	0.14	0.16	0.19	0.22	0.24
White	-0.40	-0.32	-0.25	-0.21	-0.18
Male market labor supply					
African	-0.38	-0.30	-0.23	-0.17	-0.12
Colored	3.17	3.10	3.02	2.95	2.90
Indian	0.24	0.27	0.29	0.31	0.33
White	0.03	0.09	0.14	0.17	0.20
Female domestic labor					
African	0.27	0.25	0.24	0.23	0.22
Colored	-2.10	-2.15	-2.25	-2.38	-2.55
Indian	-0.15	-0.17	-0.19	-0.21	-0.23
White	0.16	0.10	0.05	0.02	-0.01
Male domestic labor					
African	0.47	0.42	0.37	0.34	0.31
Colored	-2.37	-2.43	-2.52	-2.63	-2.77
Indian	-0.04	-0.08	-0.12	-0.15	-0.18
White	0.25	0.15	0.06	0.01	-0.03

Adults adjust their non-market time following changes in wages, but also based on their time constraints and changes in children's home labor. Increase in market labor supply both for men and women is achieved first though a reduction in leisure time and then in domestic labor. Reduced labor market participation for women in African and White households is not followed by a proportionate increase in their home labor, as in the short run. Indeed, girls' participation in home production activities is even higher in the long run (Figure 3). In contrast, boys' household work diminishes less in the long run. This allows men in Colored, Indian and White households to reduce their household work slightly more and to gain a certain level of leisure time.

The substitution of children for parents in Colored households enables parents to increase their market labor supply less in the long run and reduce their household work relatively more than in the short term (Table 4). The division of home labor between men and women is more equitable in African, Indian and White households in the long term, but only through an increase in the contribution of young girls. Moreover, boys' domestic labor diminishes less in the long run. Nevertheless, consumption of home-produced goods declines in all households except for Africans' in the long run. Consumption of marketed goods and services also declines more for all household categories. In the long run, all households see their well-being reduced due to market liberalization.

Figure 3 shows the long-term trends in girls' and boys' education and home labor time. We note that education time varies in an opposite trend compared to changes in home labor time, except among Colored households. We can see that in African households, boys' education time increases more in the long run, while their home labor diminishes more over time. In contrast, girls' education time diminishes significantly in the long run while their home labor time increases slightly. Increase in home labor time is lower than the reduction in education time for girls, indicating that girls in African households may benefit from more leisure time. In contrast, boys' education time increases more than the reduction in their home labor, resulting in a loss of leisure time in the long run.

Figure 3. Girls' and boys' time allocation (changes in absolute value over 20 years)



Unlike in other households, in Colored households children's education and home labor time increase significantly in the long run. Boys' education increases more than that of girls. Both girls' and boys' home labor increases in the long run, but the absolute variation is greater for girls. Given the higher increase in home labor and education, children in Colored households see their leisure time further reduced. In Indian households, we observe the same trend as in African households. Boys' education time increases more and more over a period of 20 years but their home labor diminishes relatively less. Girls' education time diminishes but in lower proportions than the increase in their home labor. This indicates a loss in leisure time both for girls and boys. In Indian households, while girls' home labor increases over time, their education time falls relatively less, resulting in a slight increase in leisure time. As for boys in White households, their education time increases significantly more in the long run while their home labor diminishes less, resulting in a loss in leisure time.

The increase in girls' home labor and boys' education results in a reduction in their leisure time in most households over a period of 20 years. Girls' education time diminishes in the long run except for those in Colored households, while boys' education increases relatively more. The widening gender inequality between boys and girls is maintained in the long run, confirming an intergenerational perpetuation of gender bias against women.

Conclusion

Our policy simulation evaluated the impacts of the elimination of all import tariffs in South Africa, along with a compensatory increase in indirect taxes (see Appendix). We first observe that trade liberalization initially penalizes highly protected sectors and favors export-intensive and input-intensive sectors. Wage rates and returns to capital decrease. Although the general level of consumer prices decreases, the reduction is not significant enough to raise real wages and average real rate of return to capital. Households reduce their consumption of marketed goods and services. Colored households emerge as the most negatively affected.

We also note that trade liberalization in South Africa seems to increase gender bias. We observe a slight reduction in female labor market participation while male labor market participation increases. There is also a real wage reduction for females, higher than that for their male counterparts. Changes in market labor supply come through an adjustment of home labor and leisure time. Men primarily adjust their time by reducing their leisure time and then their household work. Women tend to reduce their home labor proportionately more (or to increase it less) to benefit more from leisure time, except in Colored households, where women tend to lose leisure time, since the reduction in their home labor is proportionately less than the increase in their market labor supply.

Gender bias is likely to rise between children in terms of education time in African, Indian and White households. In contrast, gender inequalities between children are less likely to increase in Colored households, despite the fact that girls' education time increases less than that of boys. There is a general reduction of children's leisure time. Girls, deprived of education, are likely to become less skilled workers while boys, benefiting from more education time,

have a better chance of becoming skilled workers. The existing gender inequality in terms of wages is likely to be maintained into the next generation.

We note that women are able to benefit from greater leisure time due to the increase in girls' home labor. In contrast, following the decrease in boys' home labor, adult men increase their market labor supply by first reducing their leisure time and then their household work. Our results show that trade liberalization affects not only adults' time allocation but also children's. Parents' decisions concerning schooling, home labor and leisure are directly affected by changes in future gains from education relative to home labor. Furthermore, changes in children's home labor affect parents' time allocation through direct substitution effects of children for adults in household production activities. The substitution of children for parents is mainly a result of changes in relative gains from education and home labor. However, when adults' labor market participation is high, there is a pure substitution effect of children for parents in home production activities.

In conclusion, based on this model, intra-household gender based inequalities would rise as a result of trade liberalization. There would be a reduction of gender inequality within only a minority of households. Inter-household inequalities would also increase. Furthermore, there would be an intergenerational perpetuation of gender inequalities in terms of education time.

Domestic work is rarely measured and often invisible to researchers and policy makers. Our findings reveal that the burden of domestic work is carried out disproportionately by girls at the expense of their schooling, and thus their human capital accumulation. Moreover, our findings suggest that children may be required to take on tasks of adults who have increased their market labor supply. Policy makers should take into consideration the interrelations and feedbacks between market and household economies; they are not only likely to affect and be affected by the division of labor within the household between men and women, but also between adults and children. Investment in time-saving goods and services is one way to fight against gender disparities in terms of education. Improved access to water and different forms of energy can also be expected to reduce the amount of time children spend in household work and the range of their work activities. A gender-aware and time-use based approach to policy making is necessary in order to consider the diverse implications of gender relations and address problems of child poverty.

Endnotes

i. A good or service is said to be a substitute for another good if the two kinds of goods or services can be consumed or used in place of one another in at least some of their possible uses (butter and margarine, electricity and gas for energy, etc.). Hence, an increase in the price for one kind of good will result in an increase in demand for its substitutes and conversely (ceteris paribus). However, this depends if the goods are perfect or imperfect substitutes. One good is a perfect substitute for another only if it can be used in exactly the same way. Here, the utility of a combination is an increasing function of the sum of the two amounts; if the price of one good increases, there would be no demand for the more expensive good. One good is an imperfect substitute for another when it is not used in exactly the same way. Changes in price will not result in zero demand for one product to the benefit of its substitute but rather a reduction in its demand and an increase in demand for its substitute.

ii. CGE modeling is an attempt to express the flows represented in an economy as a set of simultaneous equations for a given year. The equations describe the behavior and interactions of different actors: factors, activities, commodities and institutions, and ensure that a set of both micro- and macroeconomic constraints are satisfied. Once the model is initially solved for equilibrium to ensure that the base-year dataset is reproduced, it is possible to shock the model for policy simulation purposes. Changes in the values of the endogenous variables are compared to those of the base-year equilibrium to determine the modeled impact of the exogenous shock.
iii. The social accounting matrix framework can be a useful bridge between market and non-market activities. As a flexible accounting framework it might incorporate non-market activities with comprehensive links to market activities and household and other institutional sectors. There are six types of accounts in a SAM: factors account (labor and capital); the current accounts of domestic institutions (households, firms and government); the rest of the world account; production activities accounts; commodity accounts; and the accumulation account (changes in inventories and fix capital formation). As such, it captures the diverse production activities and the interdependencies among the various sectors and institutions that characterize the South African economy. Household and personal activities may be incorporated using satellite accounts as suggested by the 1993 UN SNA classification system. The extended South African SAM for the year 2000 is a 176x176 matrix. It contains 100 accounts for market activities. Our SAM has 76 accounts for non-market activities. These include household production of non-market goods and services, educational activities, leisure activities and personal care.

    A SAM represents these accounts on a square matrix in which the payments (expenditures) are listed in columns and the receipts (income) are recorded in rows. As the sum of all expenditures by a given account (or sub-account) must equal the total sum of receipts or income for that account, it follows that each account's row sums must equal its column sums. Round (2003) explained that "the main features of a SAM are threefold. First, the...transactions are shown in the cells, so the matrix displays the interconnections between agents in an explicit way. Second, it is comprehensive, in the sense that it portrays all the economic activities of the system (consumption, production, accumulation and distribution), although not necessarily in equivalent detail. Thirdly, the SAM is flexible in that, although it is usually set up in a standard, basic framework, there is a large measure of flexibility both in the degree of disaggregation and in the emphasis placed on different parts of the economic system."
iv. Households' utility is maximized under the constraint of maximizing children's hypothetical future income. So even if increasing children's education time does not provide utility to the household, it increases the chance of children having higher pay in the future given that children are expected to become skilled workers when they benefit from more education. The constraint under which children's future income has to be maximized implies having the best combination of education and household work time given changes in the gains from each.
v. The difference in the behavior of Colored households is explained by their initial labor endowments distinguished by skill and gender. Labor income is the main source of income for all household categories but it is highest for Colored households, representing 87.12 percent, compared to 85.52 percent for Indians, 84.78 percent for Whites and 73.18 percent for Africans. Colored households are therefore relatively more affected by the decrease in real aggregate labor income. The share of unskilled male labor income that registered the highest loss in terms of wage is also more important for Colored households.

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Appendix

The Standard Model Structure

The production function in the model is a three-level constant elasticity of substitution (CES) function. At the lowest level, female labor and male labor of different skill levels are aggregated into male and female labor. To reflect the rigidity of the market between different levels of qualification, skilled/unskilled substitution is limited by setting the value of the elasticity of substitution to 0.5 on the demand side and 0.2 on the supply side. At the intermediate level, we aggregate male and female labor into one large labor bundle. Female/male substitution is also limited with a substitution elasticity value of 0.5. The production function has an upper level which combines composite labor and capital, with a substitution elasticity of 1.5. Finally, value added is combined in fixed proportions with intermediate inputs to make gross output.

Household Utility Function

Households maximize their utility under a budget constraint for consumption of marketed goods, a time constraint for adults and children, and non-market household production technology.[1] Non-market household production is modeled by a CES function that combines male composite labor (adults and boys) and female composite labor (women and girls). Male and female labor are imperfect substitutes in the production of home goods and services with a substitution elasticity of 0.5 so as to reflect rigidity in gender roles and the gender division of unpaid home labor. Household production does not require intermediate goods by assumption.[2] The value of home produced goods is equal to the value of labor devoted to their production. Unpaid household work is valued by its opportunity costs as measured by the expected wage rates in the market economy (forgone wages in the labor market). After total disposable time has been allocated to market and household work, leisure time is calculated.

Macro Closures of the Model

The model is run for 20 periods of time. Capital is sector-specific and exogenously set at the base year level for the first period. Labor is fully mobile within all market production sectors. Market labor supply is endogenously determined by each household category, taking into consideration constraints related to the supply of unpaid labor needed for home production and leisure activities. Labor supply also increases with population growth, in the same proportions for each population group.

All commodity markets follow the neoclassical market-clearing system in which each market is cleared when the total endogenous demand equals the total supply through price adjustment. The four labor markets clear when the total demand from market production sectors equals the total endogenous labor supply by the four categories of households. We do not integrate unemployment into the market clearing system. We assume that unemployment time is devoted to home production or leisure activities.

Our numeraire is the nominal exchange rate. World import and export prices are set fixed following the small price-taking economy hypothesis. Current account balance is set in fixed proportions of the GDP so as to prevent increase in foreign debt when the overall economy is contracting. Transfers within institutions (households, firms, government and the rest of the world), minimum consumption levels of market- and home-produced goods and services, and levels of the stock of capital are set fixed at the first period and increase yearly at the demographic level in order to maintain distribution per head.

Investment is savings-driven. Savings are generated in fixed proportions of households' income while firms' and public savings are residual. Government current expenditure is set exogenously and increases yearly with the population growth rate in order to maintain expenditure per head. Public saving is set at the base year level; domestic debt is thus preserved. To maintain government's budget constraint, we assume that loss of revenue from import taxes is fully recovered by the introduction of a uniform indirect tax rate. This is done through an increase in indirect tax rates by a uniform number of percentage points for all sectors, thus spreading the burden uniformly across sectors.[3]

Model Sensitivity Analysis

We also conducted a model sensitivity analysis. It consisted of modifying behavioral parameters that describe the ease in which the system adjusts to changes, in terms of simulation results. The analysis shows that the initial shares are the most important, and demonstrates the robustness of our model. We run the same model by increasing the substitution elasticity between education and household work for children. We increase it from 2 to 6 in order to increase the impact of changes in relative gains from schooling and home labor on child time allocation decisions between education and household work. This allows us to check if the substitution of girls for adult women is significant in our model. This alternative scenario confirms the existence and importance of the substitution effect in the changes in women's and men's market labor supply, household work load and leisure time. We also test the model sensitivity by running it with a substitution elasticity of 0.9 at the market level and 0.7 at the household level between female and male labor instead of the initial value of 0.5. The overall trend remains unchanged but we note that market production sectors tend to substitute more easily female for male workers. As a consequence, labor demand for women increases while it was declining in the original scenario and male labor demand increases less. Time allocation processes remain unchanged. Parents' decisions between education and household work for children remain the same. This shows that that initial shares are the most important and that changes in substitution elasticity values do not significantly affect simulation results. This also demonstrates the robustness of our model.

[1] Further details of the optimization process can be provided upon request. See also Mitik (2007).
[2] Domestic paid labor, capital goods and intermediate goods are included in the household utility function and indirectly substitute to domestic unpaid labor, which we refer to as home-produced goods.
[3] A detailed version of the model equations can be provided upon request.